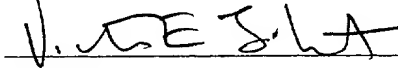


FORM PTO-1390 (REV. 10-2000)		U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE		ATTORNEY'S DOCKET NUMBER	
TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371				P-1707	
INTERNATIONAL APPLICATION NO. PCT/ZA00/00031		INTERNATIONAL FILING DATE 24 February 2000 (24.02.00)		PRIORITY DATE CLAIMED 24 February 1999 (24.02.99)	
TITLE OF INVENTION METHOD AND APPARATUS FOR PRODUCING OZONE					
APPLICANT(S) FOR DO/EO/US Barend Visser					
Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information					
<ol style="list-style-type: none"> <li>1. <input checked="" type="checkbox"/> This is a <b>FIRST</b> submission of items concerning a filing under 35 U.S.C. 371.</li> <li>2. <input type="checkbox"/> This is a <b>SECOND</b> or <b>SUBSEQUENT</b> submission of items concerning a filing under 35 U.S.C. 371</li> <li>3. <input type="checkbox"/> This is an express request to promptly begin national examination procedures (35 U.S.C. 371(f))</li> <li>4. <input checked="" type="checkbox"/> The US has been elected by the expiration of 19 months from the priority date (PCT Article 31)</li> <li>5. <input checked="" type="checkbox"/> A copy of the International Application as filed (35 U.S.C. 371(c)(2)) <ol style="list-style-type: none"> <li>a. <input checked="" type="checkbox"/> is attached hereto (required only if not communicated by the International Bureau).</li> <li>b. <input type="checkbox"/> has been communicated by the International Bureau.</li> <li>c. <input type="checkbox"/> is not required, as the application was filed in the United States Receiving Office (RO/US).</li> </ol> </li> <li>6. <input type="checkbox"/> An English language translation of the International Application as filed (35 U.S.C. 371(c)(2)).</li> <li>7. <input checked="" type="checkbox"/> Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3)) <ol style="list-style-type: none"> <li>a. <input type="checkbox"/> are attached hereto (required only if not communicated by the International Bureau).</li> <li>b. <input type="checkbox"/> have been communicated by the International Bureau.</li> <li>c. <input type="checkbox"/> have not been made; however, the time limit for making such amendments has NOT expired.</li> <li>d. <input checked="" type="checkbox"/> have not been made and will not be made.</li> </ol> </li> <li>8. <input type="checkbox"/> An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).</li> <li>9. <input type="checkbox"/> An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).</li> <li>10. <input type="checkbox"/> An English language translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).</li> </ol>					
<b>Items 11 to 16 below concern document(s) or information included:</b>					
11. <input type="checkbox"/> An Information Disclosure Statement under 37 CFR 1.97 and 1.98					
12. <input type="checkbox"/> An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.					
13. <input checked="" type="checkbox"/> A <b>FIRST</b> preliminary amendment.					
<input type="checkbox"/> A <b>SECOND</b> or <b>SUBSEQUENT</b> preliminary amendment.					
14. <input type="checkbox"/> A substitute specification.					
15. <input type="checkbox"/> A change of power of attorney and/or address letter.					
16. <input checked="" type="checkbox"/> Other items or information:					
Priority of three South African applications is claimed, as follows:					
24 February 2000 (24.02.00)					
21 January 2000 (21.01.00)					
23 February 2000 (23.02.00)					
Only the earliest claimed date is shown above.					

U.S. APPLICATION NO. <span style="float: right;">ATTORNEY'S DOCKET NUMBER</span>																											
<b>097-914197</b>	<b>P-1707</b>																										
INTERNATIONAL APPLICATION NO. PCT/ZA00/00031																											
<p><b>17.</b> <input checked="" type="checkbox"/> The following fees are submitted:</p> <p><b>BASIC NATIONAL FEE ( 37 CFR 1.492(a)(1) - (5) ) :</b></p> <p>Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO . . . . \$1000.00</p> <p>International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO . . . \$860.00</p> <p>International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO . . . . \$710.00</p> <p>International preliminary examination fee paid to USPTO (37 CFR 1.482) but all claims did not satisfy provisions of PCT Article 33(1)-(4) . . . . \$690.00</p> <p>International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(1)-(4) . . . . \$100.00</p> <p style="text-align: right;"><b>ENTER APPROPRIATE BASIC FEE AMOUNT =</b></p> <hr/> <p>Surcharge of \$130.00 for furnishing the oath or declaration later than <input type="checkbox"/> 20 <input checked="" type="checkbox"/> 30 months from the earliest claimed priority date (37 CFR 1.492(e)).</p> <table border="1" style="width: 100%; border-collapse: collapse; margin-top: 5px;"> <thead> <tr> <th style="width: 25%;">CLAIMS</th> <th style="width: 25%;">NUMBER FILED</th> <th style="width: 25%;">NUMBER EXTRA</th> <th style="width: 25%;">RATE</th> </tr> </thead> <tbody> <tr> <td>Total claims</td> <td>6 - 20 =</td> <td>0</td> <td>X \$18.00</td> </tr> <tr> <td>Independent claims</td> <td>3 - 3 =</td> <td>0</td> <td>X \$80.00</td> </tr> <tr> <td>MULTIPLE DEPENDENT CLAIM(S) (if applicable)</td> <td></td> <td></td> <td>+ \$270.00</td> </tr> <tr> <td colspan="3"><b>TOTAL OF ABOVE CALCULATIONS =</b></td> <td>\$ 990.00</td> </tr> </tbody> </table> <p><input checked="" type="checkbox"/> Applicant claims small entity status. See 37 CFR 1.27. The fees indicated above are reduced by 1/2.</p> <p style="text-align: right;"><b>SUBTOTAL =</b></p> <hr/> <p>Processing fee of \$130.00 for furnishing the English translation later than <input type="checkbox"/> 20 <input type="checkbox"/> 30 months from the earliest claimed priority date (37 CFR 1.492(f)). +</p> <p style="text-align: right;"><b>TOTAL NATIONAL FEE =</b></p> <hr/> <p>Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). \$40.00 per property +</p> <p style="text-align: right;"><b>TOTAL FEES ENCLOSED =</b></p> <table border="1" style="width: 100%; border-collapse: collapse; margin-top: 5px;"> <tr> <td style="width: 80%;"></td> <td style="width: 20%; text-align: center;">Amount to be <b>refunded:</b></td> <td style="width: 20%; text-align: center;">\$</td> </tr> <tr> <td></td> <td style="text-align: center;"><b>charged:</b></td> <td style="text-align: center;">\$</td> </tr> </table>	CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE	Total claims	6 - 20 =	0	X \$18.00	Independent claims	3 - 3 =	0	X \$80.00	MULTIPLE DEPENDENT CLAIM(S) (if applicable)			+ \$270.00	<b>TOTAL OF ABOVE CALCULATIONS =</b>			\$ 990.00		Amount to be <b>refunded:</b>	\$		<b>charged:</b>	\$	<p align="center"><b>CALCULATIONS      PTO USE ONLY</b></p> <div style="height: 200px;"></div>
CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE																								
Total claims	6 - 20 =	0	X \$18.00																								
Independent claims	3 - 3 =	0	X \$80.00																								
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	<b>charged:</b>	\$																									
<p>a. <input type="checkbox"/> A check in the amount of \$ _____ to cover the above fees is enclosed.</p> <p>b. <input checked="" type="checkbox"/> Please charge my Deposit Account No. <u>12-1302</u> in the amount of \$ <u>495.00</u> to cover the above fees. A duplicate copy of this sheet is enclosed.</p> <p>c. <input checked="" type="checkbox"/> The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. <u>12-1302</u>. A duplicate copy of this sheet is enclosed.</p> <p><b>NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.</b></p> <p>SEND ALL CORRESPONDENCE TO</p> <p><b>Libert &amp; Associates</b> 3 Mill Pond Lane P.O. Box 538 Simsbury, CT 06070-0538 United States of America</p>		<div style="text-align: center;">               SIGNATURE           </div> <hr/> <div style="text-align: center;">Victor E. Libert</div> <hr/> <div style="text-align: center;">NAME</div> <hr/> <div style="text-align: center;">24,224</div> <hr/> <div style="text-align: center;">REGISTRATION NUMBER</div>																									

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JCS Rec'd PCT/PTO 23 AUG 2001

**IN THE DESIGNATED/ELECTED OFFICE (DO/EO/US)  
OF  
THE UNITED STATES PATENT AND TRADEMARK OFFICE**

INTERNATIONAL APPLICATION NO: PCT/ZA00/00031  
APPLICANT FOR DO/EO/US: Barend Visser  
INTERNATIONAL FILING DATE: 24 February 2000 (24.02.00)  
PRIORITY DATES CLAIMED: 24 February 1999 (24.02.99);  
21 January 2000 (21.01.00);  
23 February 2000 (23.02.00)  
TITLE: METHOD AND APPARATUS FOR PRODUCING OZONE  
ATTY DKT: P-1707

**PRELIMINARY AMENDMENT**

Box PCT  
Commissioner of Patents  
Washington, DC 20231

August 23, 2001

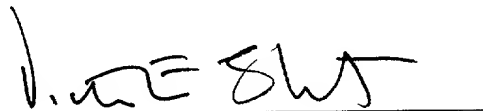
Dear Sir:

Please amend the above-captioned application, submitted concurrently herewith, as follows.

**In The Claims**

Without prejudice to the invention therein defined, please cancel claims 4, 5, 8 through 16, 18 and 19.

Respectfully submitted,



Victor E. Libert

Registration Number 24,224

Attorney for Applicants

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P.O. Box 538  
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JC05 Rec'd PCT/PTO

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**METHOD AND APPARATUS FOR PRODUCING OZONE****TECHNICAL FIELD**

This invention relates to a method and apparatus for producing ozone.

5

**BACKGROUND ART**

A known method for producing ozone includes the steps of passing oxygen at 1 atmosphere and 25°C through concentric metallised glass tubes to which low-frequency power at 50-500 Hz and 10-20 kV is applied. Due to the relatively slow change in potential (5kV per millisecond), a corona or silent electric discharge is maintained between the electrodes. A disadvantage of this method is that energy is lost in the form of heat, and a relatively low yield ratio of ozone is achieved.

15

**OBJECTIVE OF THE INVENTION**

It is accordingly an object of the present invention to provide a method and apparatus for producing ozone with which the aforesaid disadvantage may be overcome or to provide a useful alternative to the known method.

20

**SUMMARY OF THE INVENTION**

According to the invention there is provided a method of producing ozone comprising the steps of generating intermittent bursts of corona discharge in an electrode region, and passing oxygen-containing fluid through the region.

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thereby to cause ionization of the oxygen.

The intermittent bursts may be generated by generating a changing electric field in the region by energising the electrode with intermittent voltage pulses having  
5 a slope of at least 2kV/100ns, the field having a peak value of at least 2kV per millimetre. In this specification, the word "slope" is used to denote the slope between 30% and 70% of the peak to peak value of the pulse.

Preferably, the peak value is at least 3kV per millimetre and the slope is in the  
10 order of 3kV/10ns.

Each voltage pulse preferably has a pulse width of less than 100ns.

The bursts may be discrete bursts.

15

The invention also includes within its scope apparatus for producing ozone comprising:

- a housing defining a passage for a fluid comprising oxygen;
- an electrode disposed adjacent the passage; and
- 20 - pulse generating means connected to the electrode,
- the pulse generating means being operative to generate a changing electric field by generating a train of voltage pulses

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each having a slope of at least 20kV/100ns.

The electric field has a peak value of at least 3kV per millimetre.

Each voltage pulse preferably has a pulse width of less than 100ns.

5

The pulse generating means may comprise a self-oscillating circuit.

10

The self-oscillating circuit may comprise a field effect transistor (FET) and a switch circuit therefor, the switch circuit comprising charge storage means; switching means connected between the charge storage means and a gate of the FET; the switching means being operative to deposit charge from the storage means onto the gate, thereby to improve a rise time of a signal in a drain-source circuit of the FET.

15

The charge storage means may comprise a capacitor and the switch means may comprise a SIDAC.

20

The electrode may be connected to a secondary winding of a transformer, a primary winding of the transformer being connected in the drain-source circuit of the FET.

The passage may extend between an inlet to the housing and an outlet

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therefrom.

The electrode may be an annular electrode disposed in the housing and the passage may extend through a clearance defined between the electrode and an annular ridge in the housing.

The housing may be a metal housing, the housing may be connected to the secondary winding of the transformer and an insulating carrier for the electrode may be mounted on shoulder formations in the housing.

In another embodiment the housing may be of an electricity insulating material, the electrode may be disposed circumferentially on the outside of the housing and a second electrode also connected to the secondary winding may be provided spaced from an inner wall of the housing, to define the passage between the second electrode and the inner wall.

#### BRIEF DESCRIPTION OF THE DRAWINGS

The invention will now be described further, by way of example only, with reference to the accompanying drawings wherein:

- figure 1 is an exploded perspective view of apparatus according to a first embodiment of the invention for producing ozone;
- figure 2 is an exploded perspective view of a closure and electrode

assembly of the apparatus of figure 1;

figure 3 is a perspective view of the closure and electrode assembly of figure 2 when assembled;

figure 4 is a schematic representation of an electronic circuit used to generate a train of voltage pulses that is applied to the electrode assembly of figures 2 and 3.

figures 5(a);(b);(c); and (d) are voltage waveforms against a first time scale at points a, b, c, and d in figure 4;

figures 6(a);(b);(c); and (d) are the same wave forms against a larger time scale;

figure 7 is a cross-sectional view on line VII in figure 3;

figure 8 is a partially broken away perspective view of apparatus according to a second embodiment of the invention for producing ozone; and

figure 9 is a cross-sectional side view of a central portion of the apparatus of figure 8.

#### DESCRIPTION OF A PREFERRED EMBODIMENT OF THE INVENTION

Referring to figure 1, apparatus according to a first embodiment of the invention for producing ozone, is generally designated by reference numeral 10.

The apparatus 10 includes a tubular anodised aluminium housing 12 having an open end 14 and a closed end 16, and a separate closure 18 for closing the



open end. The apparatus 10 further includes an electrode assembly 20 mountable on the closure 18 and pulse generating means in the form of an electronic circuit 30 (shown in figure 4) for energising the electrode assembly 20.

5

An inlet 22 to the housing is provided in the closed end 16 and an outlet 24 is defined in the closure 18. A passage 21 (shown in figure 7) extends from the inlet 22 to the outlet 24.

10 As best shown in figures 1 and 7, the electrode assembly 20 comprises an insulating disc or base 20.1 of an ozone and corona resistant material, such as glass, alumina etc and an annular electrode 20.2 mounted on the face of the base 20.1 facing away from the closure 18. The base 20.1 is provided with a plurality of spaced peripheral notches 20.3, the purpose of which will be  
15 described hereinafter.

The closure 18 is provided with an annular ridge formation 18.1. As best shown in figure 7, when the electrode assembly 20 is mounted on shoulder formations on the closure 18, the ridge formation 18.1 is disposed in close  
20 proximity, but with a clearance 23 of approximately 0.3mm from the base 20.1.

The aforementioned passage 21 extends from the inlet 22 along the tubular

housing 12, through the notches 20.3 in the base, through the clearance 23 between the ridge formation 18.1 and the base 20.1, and out via the outlet 24.

As will be described hereinafter, a rapidly changing electric field is established in the passage 21 in the region of the ridge formation 18.1 causing a corona discharge and oxygen flowing along the passage 21 in use, therefore passes through the field. The effect of the electric field is that instantaneous ionisation of oxygen is achieved by the corona discharge to produce ozone from the oxygen, without substantial energy loss in the form of heat generated.

10

The applicant has found that the ozone yield ratio is dependant on the rise time  $t_r$ , the fall time  $t_f$  and width  $w_p$  of the pulses 50 (shown in figure 5(d)) in the train 52 of pulses (shown in figure 6(d)) applied to the electrode assembly 20. It is believed that the shorter the rise and fall times and/or the pulse width, the more efficient the apparatus becomes.

15

A self-oscillating circuit 30 for energizing the electrode assembly 20 is shown in figure 4. Voltage waveforms as measured at points a, b, c and d are shown in figures 5(a), (b), (c) and (d) respectively and also in figures 6(a), (b), (c) and (d) respectively.

20

The circuit 30 comprises a capacitor 34 in parallel with a SIDAC 36 and inductor

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37. The SIDAC is connected to the gate 39 of a field effect transistor (FET) such as a MOSFET 38 of the type IRF 740, for example. The SIDAC 36 conducts current when a voltage exceeding a certain threshold (100V for example) is applied across it. A primary winding of a transformer 43 is connected in the drain-source circuit 45 of the MOSFET 38. The secondary winding of the transformer is connected to the electrode assembly 20 as shown in figure 4.

A DC voltage of about 150V is applied at point 41 of the circuit. Initially the potential difference across the SIDAC 36 is insufficient to cause the SIDAC 36 to switch on and hence the capacitor 34 is charged up. When the voltage over the SIDAC 36 exceeds the aforementioned threshold voltage of the SIDAC 36, it switches on, resulting in a closed circuit from the capacitor 34 to the gate 39 of the MOSFET 38, partially discharging the capacitor 34 and hence charging the gate 39. The result is that a charge will now be shared between the capacitor 34 and the gate 39, so that some voltage, preferably sufficiently above the gate threshold voltage (typically 6V) relative to ground, is applied to the gate. The current that discharges from the capacitor 34 through to SIDAC 36 is applied to the gate 39 of the MOSFET 38 slightly prior to the onset of current flow in the drain-source circuit 45. As a result of the current from the capacitor, the voltage on the gate exceeds the aforementioned threshold voltage by a sufficient amount. The resulting signals at points a, b, c and d are shown in

figures 5(a) to (d) respectively and in figures 6(a) to (d), respectively.

Using this method, the gate voltage may for short intervals be driven approximately two to four times beyond the maximum threshold voltage rating of some MOSFET's without destroying the device.

As will be seen from figures 5(d) and 6(d) each of the pulses 50 in the train 52 of voltage pulses applied to the electrode assembly has a 30% - 70% slope or rise time  $t_r$  and a fall time  $t_f$  of better than 2kV/100ns, preferably in the order of 3kV/10ns. Furthermore, the width of the pulses  $w_p$  as they pass through the average value 54 is shorter than 100ns, preferably shorter than 30ns.

The peak value of the voltage applied to the electrode assembly is in the order of 3kV and with the clearance between the electrode 20.2 and the ridge 18.1 in the order of 0.3mm, the maximum electric field strength  $E$  is bigger than 3kV/mm, preferably in the order of 10kV/mm.

Referring to figures 7 and 8, apparatus according to a second embodiment of the invention for producing ozone, is generally designated by reference numeral 100.

The basic working of the apparatus 100 is similar to that of apparatus 10, but

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the construction of apparatus 100 differs in that the housing 102 is manufactured from an insulating material. The apparatus 100 includes a first electrode 104, which comprises a conductive annulus extending around the housing 102 and a second electrode 106 disposed inside the housing 102.

5

The second electrode 106 is provided with an annular ridge formation 106.1 disposed in close proximity to the inner wall of the housing 102, in the region of the first electrode 104. The first electrode 104 is connected to the self-oscillating circuit and the second electrode 106 is earthed. A corona discharge is therefore established between the ridge formation 106.1 and the inner wall of the housing 102, causing the production of ozone as hereinbefore described.

10

It will be appreciated that there are many variations in detail on the method and apparatus according to the invention without departing from the scope and spirit of the appended claims.

15

20

**CLAIMS**

1. A method of producing ozone comprising the steps of generating intermittent bursts of corona discharge in an electrode region, and  
5 passing oxygen-containing fluid through the region, thereby to cause ionization of the oxygen.
2. A method as claimed in claim 1 wherein the intermittent bursts are generated by generating a changing electric field in the region by  
10 energising the electrode with intermittent voltage pulses having a slope of at least 2kV/100ns, the field having a peak value of at least 2kV per millimetre.
3. A method as claimed in claim 2 wherein the peak value is at least 3kV  
15 per millimetre and the slope is in the order of 3kV/10ns.
4. A method as claimed in claim 2 or claim 3 wherein each voltage pulse has a pulse width of less than 100ns.
- 20 5. A method as claimed in any one of the preceding claims wherein the bursts are discrete bursts.
6. Apparatus for producing ozone comprising:

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- a housing defining a passage for a fluid comprising oxygen;
  - an electrode disposed adjacent the passage; and
  - pulse generating means connected to the electrode,
  - the pulse generating means being operative to generate a
- 5 changing electric field by generating a train of voltage pulses  
each having a slope of at least 20kV/100ns.

7. Apparatus as claimed in claim 6 wherein the electric field has a peak  
value of at least 3kV per millimetre.

10 8. Apparatus as claimed in claim 6 or claim 7 wherein each voltage pulse  
has a pulse width of less than 100ns.

15 9. Apparatus as claimed in any one of the preceding claims wherein the  
pulse generating means comprises a self-oscillating circuit.

20 10. Apparatus as claimed in claim 9 wherein the self-oscillating circuit  
comprises a field effect transistor (FET) and a switch circuit therefor, the  
switch circuit comprising charge storage means; switching means  
connected between the charge storage means and a gate of the FET;  
the switching means being operative to deposit charge from the storage  
means onto the gate, thereby to improve a rise time of a signal in a

drain-source circuit of the FET.

11. Apparatus as claimed in claim 10 wherein the charge storage means comprises a capacitor and the switch means comprises a SIDAC.

5

12. Apparatus as claimed in claim 10 or claim 11 wherein the electrode is connected to a secondary winding of a transformer, a primary winding of the transformer being connected in the drain-source circuit of the FET.

- 10 13. Apparatus as claimed in any one of claims 6 to 12 wherein the passage extends between an inlet to the housing an outlet therefrom.

14. Apparatus as claimed in any one of claims 6 to 13 wherein the electrode is an annular electrode disposed in the housing and wherein the passage extends through a clearance defined between the electrode and an annular ridge in the housing.
- 15

15. Apparatus as claimed in claim 14 wherein the housing is a metal housing, wherein the housing is also connected to the secondary winding of the transformer and wherein an insulating carrier for the electrode is disposed between the electrode and the ridge.
- 20



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16. An apparatus as claimed in claim 14 wherein the housing is of an electricity insulating material, wherein the electrode is disposed circumferentially on the outside of the housing and wherein a second electrode also connected to the secondary winding is provided spaced from an inner wall of the housing, to define the passage between the second electrode and the inner wall.

17. A method of producing ozone, the method comprising the steps of:

- generating a changing electric field in an electrode region: the field having a peak value of at least 2kV per millimetre;
- generating the electric field by energizing the electrode with intermittent voltage pulses having a slope of at least 2kV/100ns; and
- passing oxygen-containing fluid through the region.

18. A method of producing ozone substantially as herein described with reference to the accompanying diagrams.

19. Apparatus for producing ozone substantially as herein described with reference to the accompanying diagrams.

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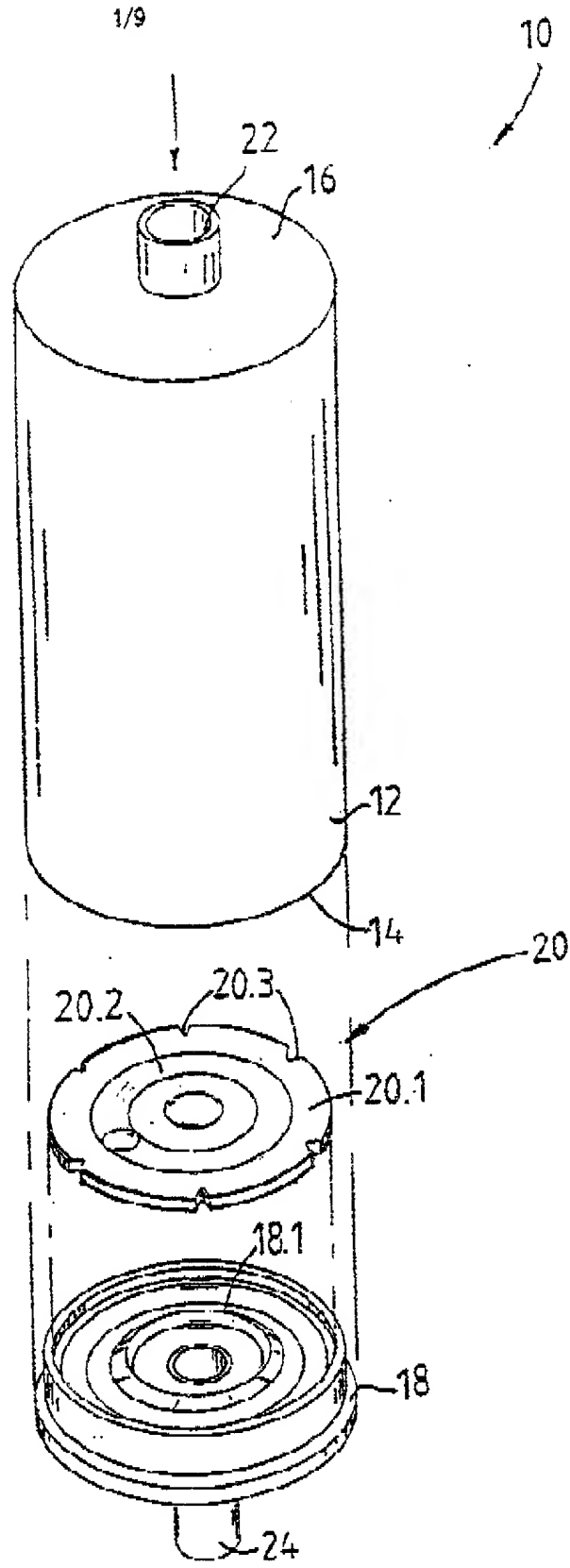


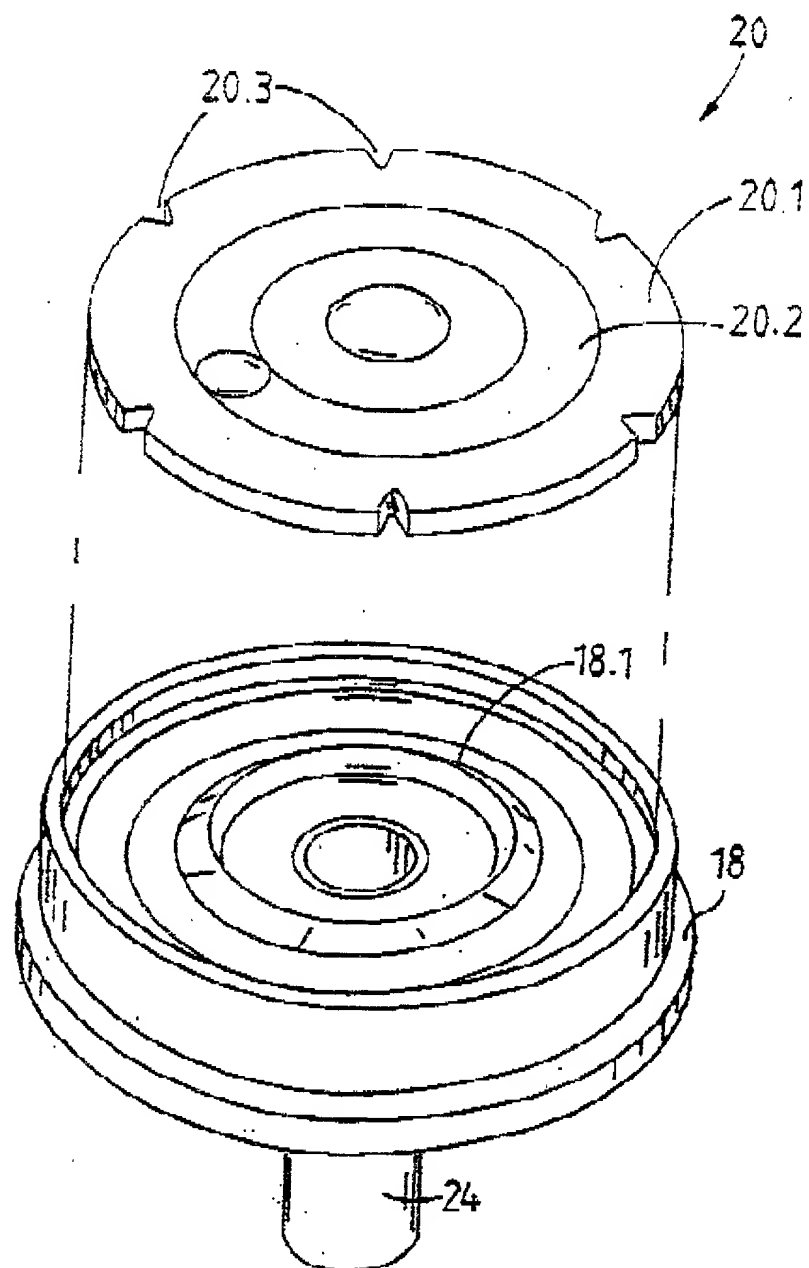
FIGURE 1

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FIGURE 2

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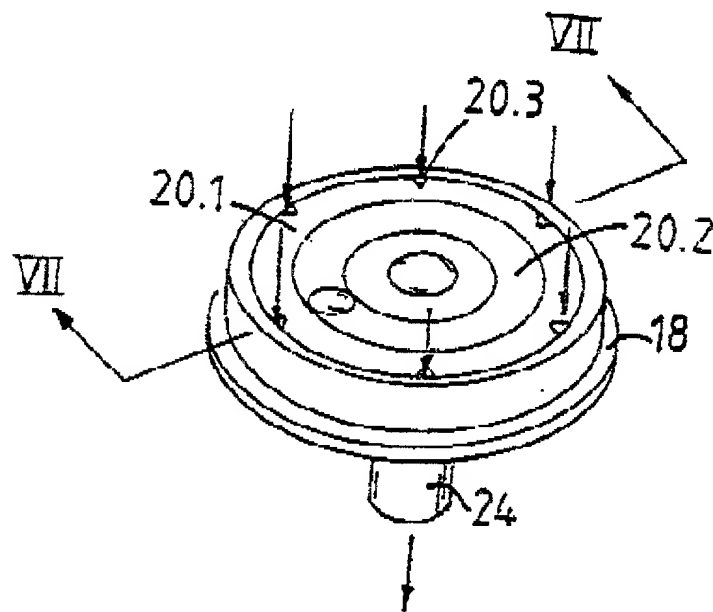


FIGURE 3

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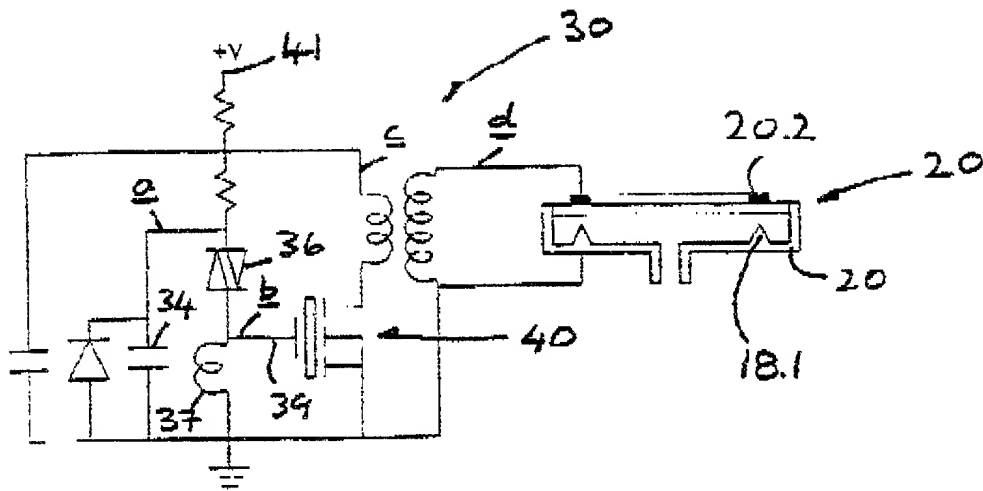


FIGURE 4

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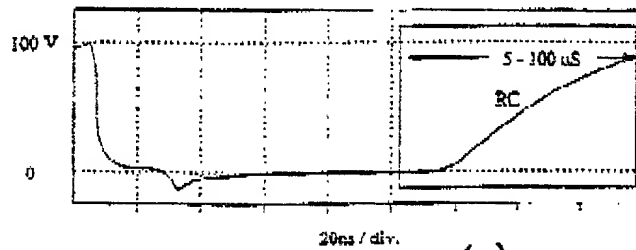


FIGURE 5(a)

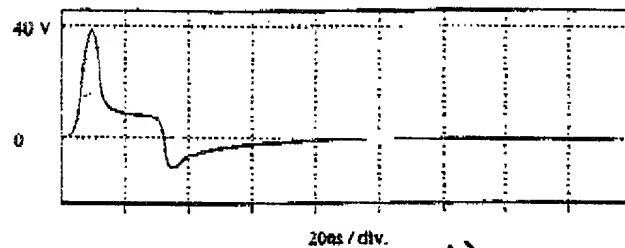


FIGURE 5(b)

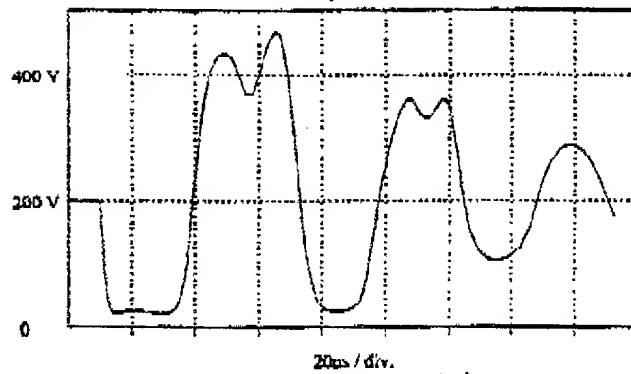


FIGURE 5(c)

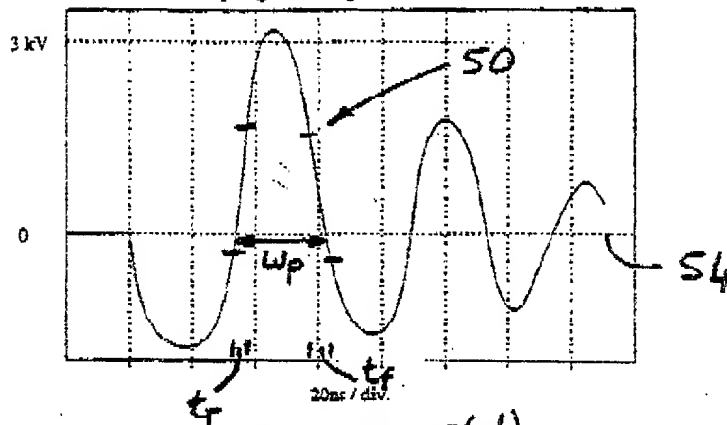


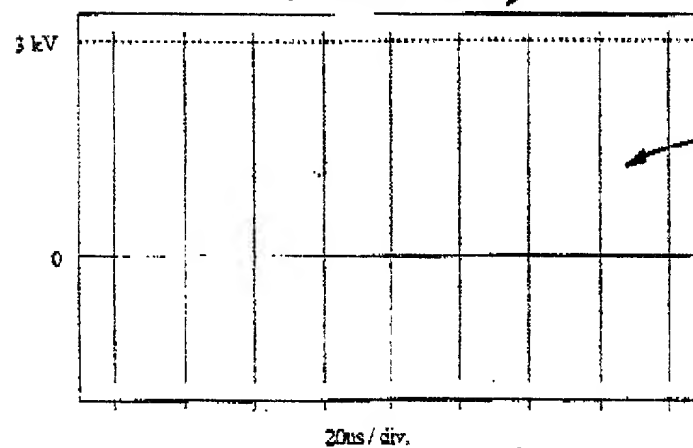
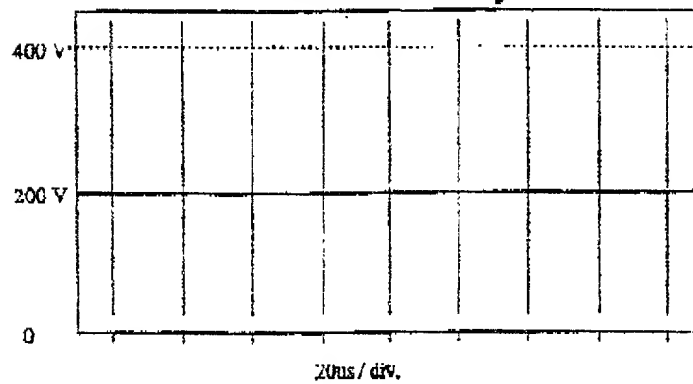
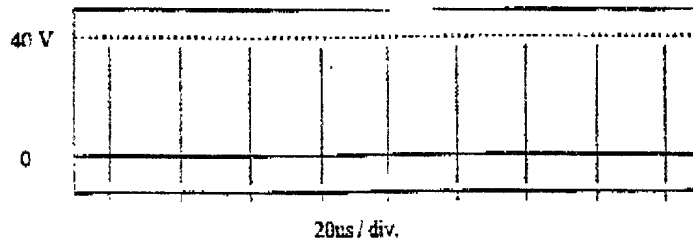
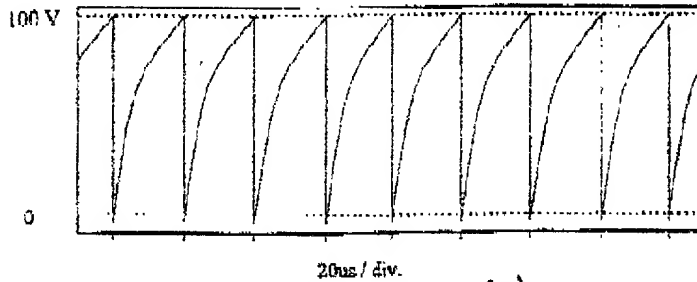
FIGURE 5(d)

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WO 00/50338

PCT/ZA00/00031

8/9

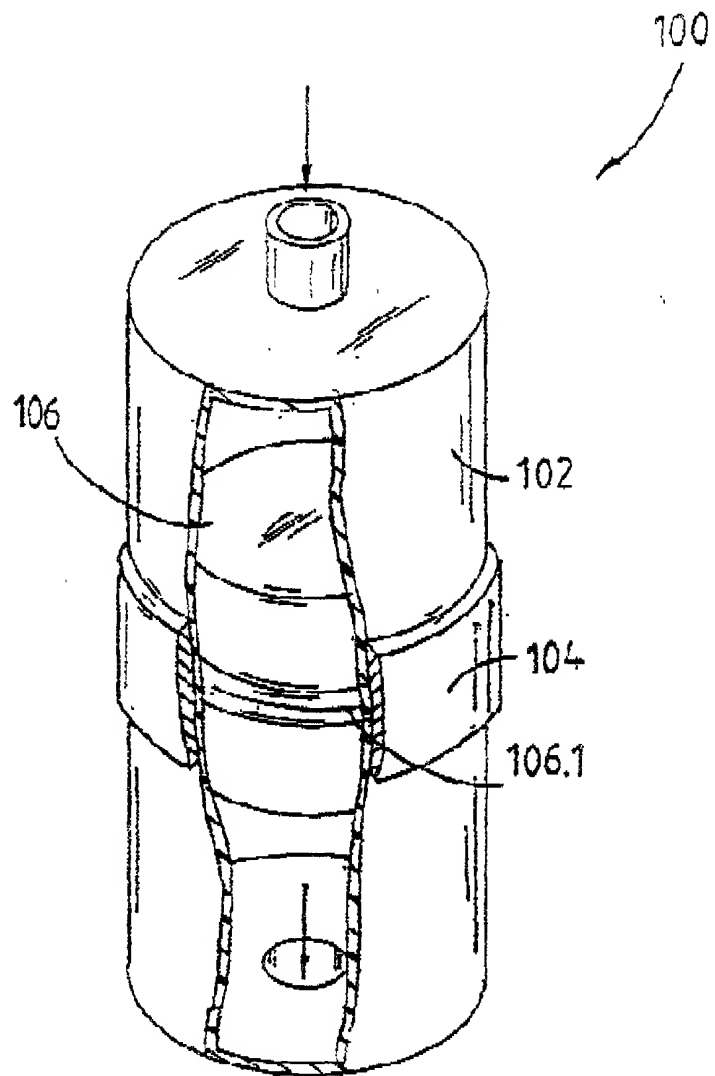


FIGURE 8

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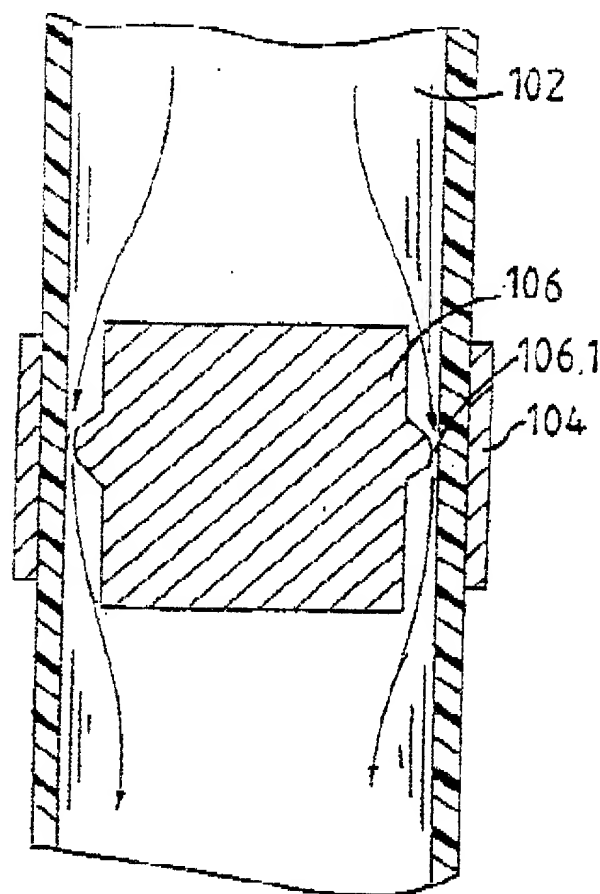


FIGURE 9

Practitioner's Docket No. P-1707**PATENT****COMBINED DECLARATION AND POWER OF ATTORNEY**(ORIGINAL, DESIGN, NATIONAL STAGE OF PCT, SUPPLEMENTAL, DIVISIONAL,  
CONTINUATION, OR C-I-P)

As a below named inventor, I hereby declare that:

**TYPE OF DECLARATION**

This declaration is of the following type:

(check one applicable item below)

☐ original.☐ design.

NOTE: With the exception of a supplemental oath or declaration submitted in a reissue, a supplemental oath or declaration is not treated as an amendment under 37 CFR 1.312 (Amendments after allowance). M.P.E.P. § 714.16, 7th Edition.

☐ supplemental.

NOTE: If the declaration is for an International Application being filed as a divisional, continuation or continuation-in-part application, do not check next item; check appropriate one of last three items.

☒ national stage of PCT.

NOTE: If one of the following 3 items apply, then complete and also attach ADDED PAGES FOR DIVISIONAL, CONTINUATION OR C-I-P.

NOTE: See 37 C.F.R. § 1.63(d) (continued prosecution application) for use of a prior nonprovisional application declaration in the continuation or divisional application being filed on behalf of the same or fewer of the inventors named in the prior application.

☐ divisional.☐ continuation.

NOTE: Where an application discloses and claims subject matter not disclosed in the prior application, or a continuation or divisional application names an inventor not named in the prior application, a continuation-in-part application must be filed under 37 C.F.R. § 1.53(b) (application filing requirements — nonprovisional application).

☐ continuation-in-part (C-I-P).**INVENTORSHIP IDENTIFICATION**

**WARNING:** If the inventors are each not the inventors of all the claims, an explanation of the facts, including the ownership of all the claims at the time the last claimed invention was made, should be submitted.

My residence, post office address and citizenship are as stated below, next to my name. I believe that I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter that is claimed, and for which a patent is sought on the invention entitled:

**TITLE OF INVENTION**METHOD AND APPARATUS FOR PRODUCING OZONE 

## SPECIFICATION IDENTIFICATION

the specification of which:

(complete (a), (b), or (c))

(a) ☐ is attached hereto.

NOTE: "The following combinations of information supplied in an oath or declaration filed on the application filing date with a specification are acceptable as minimums for identifying a specification and compliance with any one of the items below will be accepted as complying with the identification requirement of 37 CFR 1.63:

"(1) name of inventor(s), and reference to an attached specification which is both attached to the oath or declaration at the time of execution and submitted with the oath or declaration on filing;

"(2) name of inventor(s), and attorney docket number which was on the specification as filed;  
or

"(3) name of inventor(s), and title which was on the specification as filed."

Notice of July 13, 1995 (1177 O.G. 60).

(b) ☒ was filed on August 23, 2001, as ☒ Serial No. 09/914,199

and was amended on August 23, 2001 (if applicable).

NOTE: Amendments filed after the original papers are deposited with the PTO that contain new matter are not accorded a filing date by being referred to in the declaration. Accordingly, the amendments involved are those filed with the application papers or, in the case of a supplemental declaration, are those amendments claiming matter not encompassed in the original statement of invention or claims. See 37 C.F.R. § 1.67.

NOTE: "The following combinations of information supplied in an oath or declaration filed after the filing date are acceptable as minimums for identifying a specification and compliance with any one of the items below will be accepted as complying with the identification requirement of 37 CFR 1.63:

"(A) application number (consisting of the series code and the serial number, e.g., 08/123,456);

"(B) serial number and filing date;

"(C) attorney docket number which was on the specification as filed;

"(D) title which was on the specification as filed and reference to an attached specification which is both attached to the oath or declaration at the time of execution and submitted with the oath or declaration; or

"(E) title which was on the specification as filed and accompanied by a cover letter accurately identifying the application for which it was intended by either the application number (consisting of the series code and the serial number, e.g., 08/123,456), or serial number and filing date. Absent any statement(s) to the contrary, it will be presumed that the application filed in the PTO is the application which the inventor(s) executed by signing the oath or declaration."

M.P.E.P. § 601.01(a), 7th Ed.

(c) ☒ was described and claimed in PCT International Application No. PCT/ZA00/00031, filed on February 24, 2000 and as amended under PCT Article 19 on \_\_\_\_\_ (if any).

(Declaration and Power of Attorney [1-1]—page 2 of 7)

**SUPPLEMENTAL DECLARATION (37 C.F.R. § 1.67(b))**

(complete the following where a supplemental declaration is being submitted)

- ☐ I hereby declare that the subject matter of the
- ☐ attached amendment
- ☐ amendment filed on \_\_\_\_\_

was part of my/our invention and was invented before the filing date of the original application, above-identified, for such invention.

**ACKNOWLEDGEMENT OF REVIEW OF PAPERS AND DUTY OF CANDOR**

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information, which is material to patentability as defined in 37, Code of Federal Regulations, § 1.56,

(also check the following items, if desired)

- ☒ and which is material to the examination of this application, namely, information where there is a substantial likelihood that a reasonable Examiner would consider it important in deciding whether to allow the application to issue as a patent, and
- ☐ in compliance with this duty, there is attached an information disclosure statement, in accordance with 37 C.F.R. § 1.98.

**PRIORITY CLAIM (35 U.S.C. §§ 119(a)-(d))**

NOTE: "The claim to priority need be in no special form and may be made by the attorney or agent if the foreign application is referred to in the oath or declaration as required by § 1.63. The claim for priority and the certified copy of the foreign application specified in 35 U.S.C. 119(b) must be filed in the case of an interference (§ 1.630), when necessary to overcome the date of a reference relied upon by the examiner, when specifically required by the examiner, and in all other situations, before the patent is granted. If the claim for priority or the certified copy of the foreign application is filed after the date the issue fee is paid, it must be accompanied by a petition requesting entry and by the fee set forth in § 1.17(i). If the certified copy is not in the English language, a translation need not be filed except in the case of interference; or when necessary to overcome the date of a reference relied upon by the examiner; or when specifically required by the examiner, in which event an English language translation must be filed together with a statement that the translation of the certified copy is accurate." 37 C.F.R. § 1.55(a).

I hereby claim foreign priority benefits under Title 35, United States Code, §§ 119(a)-(d) of any foreign application(s) for patent or inventor's certificate or of any PCT international application(s) designating at least one country other than the United States of America listed below and have also identified below any foreign application(s) for patent or inventor's certificate or any PCT international application(s) designating at least one country other than the United States of America filed by me on the same subject matter having a filing date before that of the application(s) of which priority is claimed.

(complete (d) or (e))

- (d) ☐ no such applications have been filed.
- (e) ☒ such applications have been filed as follows.

NOTE: Where item (c) is entered above and the International Application which designated the U.S. itself claimed priority check item (e), enter the details below and make the priority claim.

**PRIOR FOREIGN/PCT APPLICATION(S) FILED WITHIN 12 MONTHS  
(6 MONTHS FOR DESIGN) PRIOR TO THIS APPLICATION  
AND ANY PRIORITY CLAIMS UNDER 35 U.S.C. § 119(a)-(d)**

COUNTRY (OR INDICATE IF PCT)	APPLICATION NUMBER	DATE OF FILING (day, month, year)	PRIORITY CLAIMED UNDER 37 USC 119
ZA	99/1479	24 FEB 1999	<input checked="" type="checkbox"/> YES    NO <input type="checkbox"/>
ZA	00/0259	21 JAN 2000	<input checked="" type="checkbox"/> YES    NO <input type="checkbox"/>
ZA	00/0887	23 FEB 2000	<input checked="" type="checkbox"/> YES    NO <input type="checkbox"/>
			<input type="checkbox"/> YES    NO <input type="checkbox"/>
			<input type="checkbox"/> YES    NO <input type="checkbox"/>

**CLAIM FOR BENEFIT OF PRIOR U.S. PROVISIONAL APPLICATION(S)**  
(34 U.S.C. § 119(e))

I hereby claim the benefit under Title 35, United States Code, § 119(e) of any United States provisional application(s) listed below:

**PROVISIONAL APPLICATION NUMBER**

**FILING DATE**

\_\_\_\_\_/\_\_\_\_\_  
\_\_\_\_\_/\_\_\_\_\_  
\_\_\_\_\_/\_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**CLAIM FOR BENEFIT OF EARLIER US/PCT APPLICATION(S)  
UNDER 35 U.S.C. § 120**

- ☐ The claim for the benefit of any such applications are set forth in the attached ADDED PAGES TO COMBINED DECLARATION AND POWER OF ATTORNEY FOR DIVISIONAL, CONTINUATION OR CONTINUATION-IN PART (C-I-P) APPLICATION.

(Declaration and Power of Attorney [1-1]—page 4 of 7)

*BL*

**ALL FOREIGN APPLICATION(S), IF ANY, FILED MORE THAN 12 MONTHS  
(6 MONTHS FOR DESIGN) PRIOR TO THIS U.S. APPLICATION**

NOTE: If the application filed more than 12 months from the filing date of this application is a PCT filing forming the basis for this application entering the United States as (1) the national stage, or (2) a continuation, divisional, or continuation-in-part, then also complete ADDED PAGES TO COMBINED DECLARATION AND POWER OF ATTORNEY FOR DIVISIONAL, CONTINUATION OR C-I-P APPLICATION for benefit of the prior U.S. or PCT application(s) under 35 U.S.C. § 120.

**POWER OF ATTORNEY**

I hereby appoint the following practitioner(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith.

(list name and registration number)

Victor E. Libert  
Reg. No. 24,224

Frederick A. Spaeth  
Reg. No. 33,793

②

(check the following item, if applicable)

- ☒ I hereby appoint the practitioner(s) associated with the Customer Number provided below to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith.
- ☒ Attached, as part of this declaration and power of attorney, is the authorization of the above-named practitioner(s) to accept and follow instructions from my representative(s).

NOTE: "Special care should be taken in continuation or divisional applications to ensure that any change of correspondence address in a prior application is reflected in the continuation or divisional application. For example, where a copy of the oath or declaration from the prior application is submitted for a continuation or divisional application filed under 37 CFR 1.53(b) and the copy of the oath or declaration from the prior application designates an old correspondence address, the Office may not recognize, in the continuation or divisional application, the change of correspondence address made during the prosecution of the prior application. Applicant is required to identify the change of correspondence address in the continuation or divisional application to ensure that communications from the Office are mailed to the current correspondence address. 37 CFR 1.63(d)(4)." § 601.03, M.P.E.P., 7th Edition.

**SEND CORRESPONDENCE TO**

☐ Address

**DIRECT TELEPHONE CALLS TO:**  
(Name and telephone number)

Victor E. Libert  
(860) 651-9321

☒ Customer Number 20978

(complete the following if applicable)

Since this filing is a ☐ continuation ☐ divisional there is attached hereto a Change of Correspondence Address so that there will be no question as to where the PTO should direct all correspondence.

*EL*

## DECLARATION

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

**SIGNATURE(S)**

**NOTE:** Carefully indicate the family (or last) name, as it should appear on the filing receipt and all other documents.

**NOTE:** Each inventor must be identified by full name, including the family name, and at least one given name without abbreviation together with any other given name or initial, and by his/her residence, post office address and country of citizenship. 37 CFR § 1.63(a)(3).

NOTE: *Inventors may execute separate declarations/oaths provided each declaration/oath sets forth all the inventors. Section 1.63(a)(3) requires that a declaration/oath, inter alia, identify each inventor and prohibits the execution of separate declarations/oaths which each sets forth only the name of the executing inventor. 62 Fed. Reg. 53,131, 53,142, October 10, 1997,*

**Full name of sole or first inventor**

<u>Barend</u>	<u>---</u>	<u>Visser</u>
(GIVEN NAME)	(MIDDLE INITIAL OR NAME)	FAMILY (OR LAST NAME)

Inventor's signature K. J. Sauer

Date 16th January, 2003 Country of Citizenship South Africa

**Residence** 30 Reitz Street, Potchefstroom, 2531, Republic of South Africa

Post Office Address Same as residence 24

**Full name of second joint inventor, if any**

<u>(GIVEN NAME)</u>	<u>(MIDDLE INITIAL OR NAME)</u>	<u>FAMILY (OR LAST NAME)</u>
---------------------	---------------------------------	------------------------------

**Inventor's signature** \_\_\_\_\_

**Date** \_\_\_\_\_ **Country of Citizenship** \_\_\_\_\_

Residence \_\_\_\_\_

Post Office Address \_\_\_\_\_

**Full name of third joint inventor, if any**

<u>(GIVEN NAME)</u>	<u>(MIDDLE INITIAL OR NAME)</u>	<u>FAMILY (OR LAST NAME)</u>
---------------------	---------------------------------	------------------------------

**Inventor's signature** \_\_\_\_\_

**Date** \_\_\_\_\_ **Country of Citizenship** \_\_\_\_\_

**Residence** \_\_\_\_\_

Post Office Address \_\_\_\_\_

(Declaration and Power of Attorney [1-1]—page 6 of 7)



(check proper box(es) for any of the following added page(s)  
that form a part of this declaration)

- ☐ **Signature** for fourth and subsequent joint inventors. *Number of pages added* \_\_\_\_\_

\* \* \*

- ☐ **Signature** by administrator(trix), executor(trix) or legal representative for deceased or incapacitated inventor. *Number of pages added* \_\_\_\_\_

\* \* \*

- ☐ **Signature** for inventor who refuses to sign or cannot be reached by person authorized under 37 CFR 1.47. *Number of pages added* \_\_\_\_\_

\* \* \*

- ☐ Added page for **signature** by one joint inventor on behalf of deceased inventor(s) where legal representative cannot be appointed in time. (37 CFR 1.47)

\* \* \*

- ☐ Added pages to combined declaration and power of attorney for divisional, continuation, or continuation-in-part (C-I-P) application.

☐ Number of pages added \_\_\_\_\_

\* \* \*

- ☒ Authorization of practitioner(s) to accept and follow instructions from representative.

\* \* \*

(if no further pages form a part of this Declaration,  
then end this Declaration with this page and check the following item)

- ☐ **This declaration ends with this page.**

Practitioner's Docket No. P-1707**PATENT**

**ADDED PAGE TO COMBINED DECLARATION AND POWER OF  
ATTORNEY FOR AUTHORIZATION OF ATTORNEY(S) TO ACCEPT AND  
FOLLOW INSTRUCTIONS FROM REPRESENTATIVE**

The undersigned to this declaration and power of practitioner hereby authorizes the U.S. practitioner(s) named herein to accept and follow instructions from

D.M. Kisch Inc.

Name(s) of authorized representative(s)

66 Wierda Road East, Wierda Valley

Address

P.O. Box 781218, Sandton 2146South Africa

as to any actions to be taken in the Patent and Trademark Office regarding this application without direct communication between the U.S. practitioner(s) and the undersigned. In the event of a change in the person(s) from whom instructions may be taken, the U.S. practitioner(s) will be so notified by the undersigned.